

GUIDED SEARCH VS. SIGNAL DETECTION THEORY IN TARGET

LOCALIZATION TASKS ((M.P. Eckstein^{1, 2}, B.R. Beutter², J. Bartroff¹, L.S. Stone²))

¹Department of Medical Physics & Imaging, Cedars Sinai Medical Center, Los Angeles, CA;

²NASA Ames Research Center

Purpose: Two current models that are used to predict human search performance are the Guided Search model, a serial processing model that is guided by a parallel stage (GS; Wolfe et al., 1989) and the Signal Detection Theory model, a parallel processing model that takes into account the inherent noise in the visual system (SDT; Green & Swets, 1966). Even though these two models are fundamentally different, it has been difficult to compare them because the GS model has been developed for response-time studies and the SDT model for search accuracy tasks. In addition, as proposed by Wolfe (1994) the GS model requires Monte Carlo simulations, a method that makes parameter estimation difficult. The goal of the present study is to use a recently-developed closed-form extension of the GS model to localization tasks (LGS model; Eckstein & Beutter, ECVP 1998) to compare the two models. **Methods:** Two observers (one naïve) searched for a bright ellipses (either 75.05, 76.95, 82.65 and 86.45 cd/m²) among 2, 4, 8, or 16 dim ellipses (71.25 cd/m²) along the circumference of a circle ($r = 3.5^\circ$) centered on a fixation cross. The display was briefly presented for 100 ms followed by a 1s mask. **Results:** The SDT model was fit to the entire data set using one parameter, a proportionality constant between d' and contrast. While the LGS model has in principle 16 free parameters (4x4), examination of the parameter space showed that the data were well fit if all parameters except the signal strength were fixed at their optimal values. The signal strength was described by a linear relationship (a slope and intercept). This 5 parameter version of the LGS model was fit to the data. Both models, the SDT and LGS model resulted in excellent fits of the human data ($P(\chi^2_{\text{red}} < 0.50)$).

Conclusions: Human accuracy localizing a contrast defined target among distractors is well predicted by both the SDT model and an extension of the guided search model to localization (LGS). The former has the advantage of being simpler and computationally less time consuming. Supported by NIH-RO1HL 53455 and by NASA RTOPs 548-50-12, 131-20-30, & NCC 2-1027.

